Selecting Regulators

The selection of a regulator is important in determining the output ripple and the output voltage as primary considerations. Its selection will depend on the input voltage range, output current, and other factors as secondary considerations. Generally, we classify regulators as either **linear** or **switching** type.

In class, we have seen a few linear regulator circuits built using only diodes. In particular, we saw two main types:

1. **Series Diode Regulator** – Best used in cases with low variation in V_{IN}; drops the voltage by a relatively fixed voltage, even with large changes in load. Also useful for high output current due to the way diodes scale.
2. **Shunt Diode Regulator** – Best used in low power applications (low current in particular); in those applications it delivers moderate to good performance.

We will not cover the design of these circuits here, as this information is available through the class notes. Later, through the introduction of transistors, we can improve the performance of the above circuits further. In general, circuits such as the above are used in cases where our specification requires voltages, currents, ripple voltages, etc. that are outside the feasible range for a single, integrated part.

However, for this assignment (and in many real-world cases), we can select an all-in-one solution. These **integrated circuits** (ICs) combine many parts (diodes, transistors, op-amps, etc.) into a single package, and usually provide moderate to good performance with few extra parts. We will focus on their selection here. As mentioned above, they are usually classified as either linear or switching type. For the sections that follow, we will use an earlier class example – the full-wave example on p. 165. The relevant information is copied below:

Input Specifications	Desired Output Specifications
$V_{IN} \geq 12\ V$	$V_{OUT} = 10\ V$ $I_{LOAD} \leq 1\ A$ $Ripple\ Rejection \geq 40\ dB$

To begin, we should decide on the general part type we want to select. This is mainly decided by the power levels present and by the difference from V_{IN} to V_{OUT}.

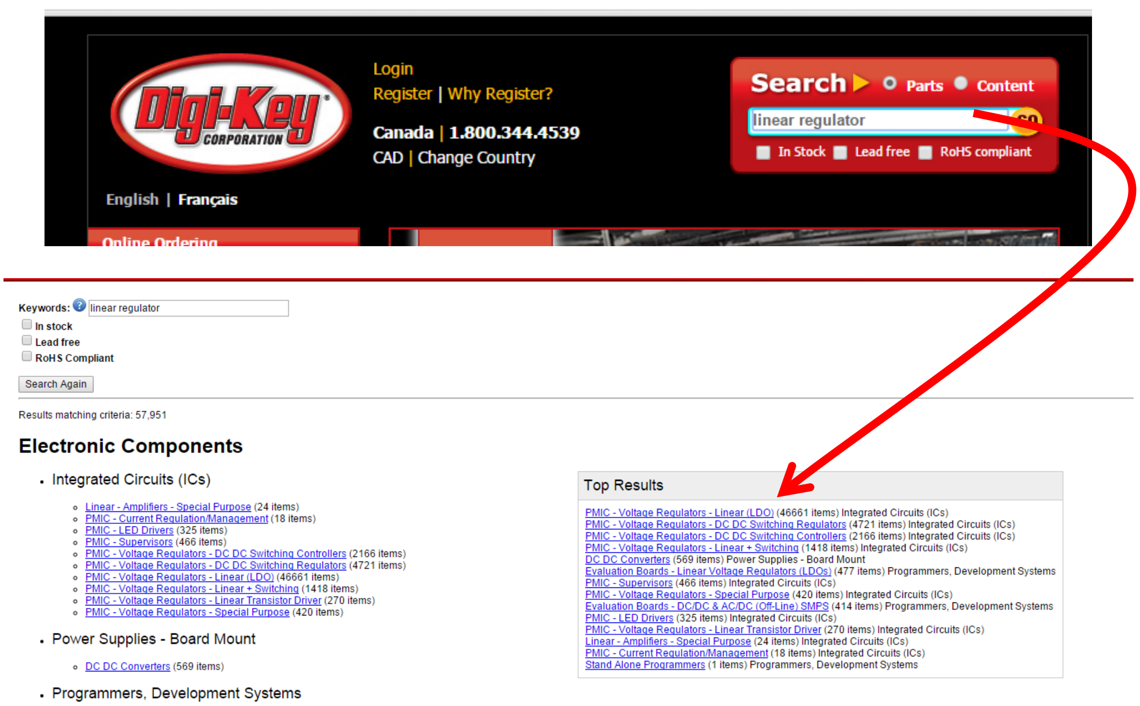
A **linear regulator** purely **reduces** voltage from input to output. Furthermore, any difference in voltage is dissipated by the linear regulator as heat – the regulator dissipates $(V_{OUT} - V_{IN})I_{LOAD}$ at any given time. Thus, linear regulators are best used in circumstances where (i) the power output needed is low, and (ii) the difference from V_{IN} to V_{OUT} will be small, yet V_{IN} is always greater than V_{OUT}. In general, this solution will be (i) cheap, and requires few extra parts, but (ii) physically larger and (iii) inefficient, especially at high power output. For this problem, however, our power output is only $(10)(1) = 10\ W$ at maximum, which is relatively low.

A **switching regulator** is actually a complex circuit. It often requires added components, such as extra transistors, inductors, capacitors, and resistors. It acts by actually *switching* the incoming DC rapidly to create a high-frequency AC signal. Then, using some type of inductor/diode or small transformer, it modifies the voltage level as needed (using PWM of the AC signal) and converts back to DC. This process means that the solution (i) generally needs more components and is more complex and expensive than a linear regulator, but (ii) is much more efficient and often smaller for a given power output. It is best used in cases of high power requirements. Note that some configurations can actually **boost** a lower input voltage to a higher one, or accept a range that spans V_{OUT}. For instance, a switching regulator that accepts $V_{IN} \sim 8V\ to\ 15V$ and produces $V_{OUT} = 12V$ is certainly possible, but a linear regulator with this specification would not be. The benefits of a switching regulator are usually most relevant for high power output, but they can also be used in cases like this one.

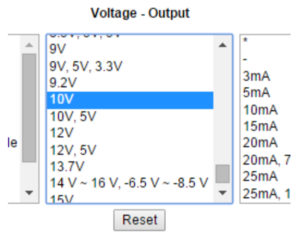
We will now examine selecting each regulator type separately.

Linear Regulator Selection Process

1. To begin, go to your favourite manufacturer or distributor website and navigate to the section for linear regulators. For this example, I will use Digikey (www.digikey.ca), a large electronics distributor:

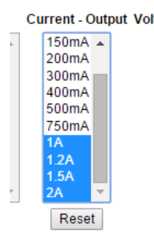


2. We select the 'Voltage Regulators – Linear' category. Results appear and can be sorted and filtered by various properties. From here, we will use our specifications to narrow down the options to suitable devices, and then pick the best for the job. To begin, we can select the output range:

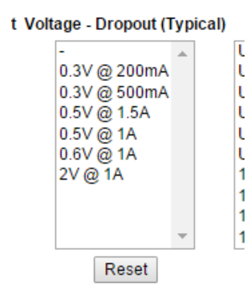


Notice that at least one fixed-output regulator is available for $V_{OUT} = 10\ V$. You will also notice in the list some entries that are **adjustable** (such as ‘14V ~ 16V’ above). Usually, these parts can have their output adjusted, often through some added resistors or a potentiometer. If this function is not needed, you should prefer the fixed type, such as the one selected above. But, it is also acceptable to select a variable type and fix the output later if you cannot find a suitable fixed-output type.

3. Selecting the above and moving on, we can also incorporate the load current. Since $I_{LOAD} \leq 1\ A$, we can select any regulator with output current of $1\ A$ or greater. If we are going for a low-cost design, we can pick something close to $1\ A$. However, it may be good to include a safety margin here to avoid damage. I select all regulators of current $1A$ or higher to see what is available:



4. We need to also consider the regulator **dropout** – this is the smallest difference between V_{IN} and V_{OUT} for which the regulator can work. Since $V_{IN} \geq 12\ V$ and $V_{OUT} = 10\ V$, the smallest difference is $2\ V$. Notice that for all of the currently listed regulators, the minimum dropout is $2\ V$ or smaller, so they all can work:



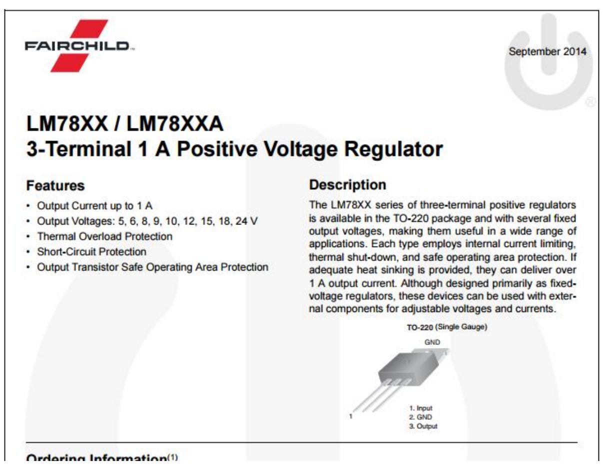
5. At this point, the only additional selection we could do would be if we knew the **maximum** V_{IN} that was available. Since we do not yet (typical at this design stage), we can move on to pick the

part by secondary feature, such as cost, size, extra parts needed, etc. We should also check the ripple rejection, although almost all regulators available will exceed $40\ dB$.

6. Let’s assume our primary design goal was low cost. Sorting by price, we see the following list. Note that I have dropped out of stock parts and set our quantity to 10000 for more accurate pricing.

Compare Parts		Image	Digi-Key Part Number	Manufacturer Part Number	Manufacturer	Description	Quantity Available	Unit Price CAD	Minimum Quantity	Packaging	Series	Regulator Topology	Voltage - Output	Current - Output	Voltage - Dropout (Typical)	Number of Regulators	Voltage - Input	Current - Limit (Min)	Operating Temperature	Mounting Type	Package / Case	Supplier Device Package
			LM7810ACT-ND	LM7810ACT	Fairchild Semiconductor	IC REG LDO 10V 1A TO220-3	1,040 - Immediate 3,000 - Factory Stock	0.28836 @ qty 10,000	1	Tube	-	Positive Fixed	10V	1A	2V @ 1A	1	Up to 35V	-	0°C ~ 125°C	Through Hole	TO-220-3	TO-220-3
			LM7810CT-ND	LM7810CT	Fairchild Semiconductor	IC REG LDO 10V 1A TO220-3	Immediate 3,000 - Factory Stock	0.28836 @ qty 10,000	1	Tube	-	Positive Fixed	10V	1A	2V @ 1A	1	Up to 35V	-	-40°C ~ 125°C	Through Hole	TO-220-3	TO-220-3
			KA7810ETUFS-ND	KA7810ETU	Fairchild Semiconductor	IC REG LDO 10V 1A TO220-3	1,209 - Immediate	0.29623 @ qty 10,000	1	Tube	-	Positive Fixed	10V	1A	2V @ 1A	1	Up to 35V	-	0°C ~ 125°C	Through Hole	TO-220-3	TO-220-3
			KA7810AETU-ND	KA7810AETU	Fairchild Semiconductor	IC REG LDO 10V 1A TO220-3	4,577 - Immediate 2,000 - Factory Stock	0.32728 @ qty 10,000	1	Tube	-	Positive Fixed	10V	1A	2V @ 1A	1	Up to 35V	-	0°C ~ 125°C	Through Hole	TO-220-3	TO-220-3
			BDJ0GC0WEFJ-E2TR-ND	BDJ0GC0WEFJ-E2	Rohm Semiconductor	IC REG LDO 10V 1A 8HTSOP-J	5,000 - Immediate	0.37440 @ qty 10,000	2,500	Tape & Reel (TR) Alternate Packaging	-	Positive Fixed	10V	1A	0.6V @ 1A	1	Up to 14V	-	-25°C ~ 85°C	Surface Mount	8-SOIC (0.154", 3.90mm Width) Exposed Pad	8-HTSOP-J
		Photo Not Available	BA7810CP-E2TR-ND	BA7810CP-E2	Rohm Semiconductor	IC REG LDO 10V 1A TO220CP-3	500 - Immediate	0.40728 @ qty 10,000	500 Non-Stock	Tape & Reel (TR) Alternate Packaging	-	Positive Fixed	10V	1A	2V @ 1A	1	12.5 V ~ 25 V	-	-40°C ~ 85°C	Through Hole	TO-220-3 Cropped Leads	TO-220CP-3
			497-6039-5-ND	L78S10CV	STMicroelectronics	IC REG LDO 10V 2A TO220AB	3,830 - Immediate	0.45239 @ qty 10,000	1	Tube	-	Positive Fixed	10V	2A	-	1	Up to 35V	-	0°C ~ 150°C	Through Hole	TO-220-3	TO-220AB
			296-20797-2-ND	UA7810CKTTR	Texas Instruments	IC REG LDO 10V 1.5A DDPAK	2,000 - Immediate 7,500 - Factory Stock	0.45342 @ qty 10,000	500	Tape & Reel (TR) Alternate Packaging	-	Positive Fixed	10V	1.5A	2V @ 1A	1	12.5 V ~ 28 V	-	0°C ~ 125°C	Surface Mount	TO-263-4, D²Pak (3 Leads + Tab), TO-263AA	DDPAK/TO-263-3
			296-21621-5-ND	UA7810CKCS	Texas Instruments	IC REG LDO 10V 1.5A TO220-3	1,288 - Immediate	0.45456 @ qty 10,000	1	Tube Alternate Packaging	-	Positive Fixed	10V	1.5A	2V @ 1A	1	12.5 V ~ 28 V	-	0°C ~ 125°C	Through Hole	TO-220-3	TO-220-3
						IC REG LDO 10V	1 - Immediate 10,000 -	0.45456	1	Tube		Positive					12.5 V ~			Through		

7. Let’s check the cheapest part. We should look at the part **datasheet** at this point to find out any remaining unknown information. Opening the datasheet for the LM7810, we are presented with a summary of the part features:


FAIRCHILD

September 2014

LM78XX / LM78XXA
3-Terminal 1 A Positive Voltage Regulator

Features

- Output Current up to 1 A
- Output Voltages: 5, 6, 8, 9, 10, 12, 15, 18, 24 V
- Thermal Overload Protection
- Short-Circuit Protection
- Output Transistor Safe Operating Area Protection

Description

The LM78XX series of three-terminal positive regulators is available in the TO-220 package and with several fixed output voltages, making them useful in a wide range of applications. Each type employs internal current limiting, thermal shut-down, and safe operating area protection. If adequate heat sinking is provided, they can deliver over 1 A output current. Although designed primarily as fixed-voltage regulators, these devices can be used with external components for adjustable voltages and currents.

TO-220 (Single Gauge)

GND

1

1. Input
2. GND
3. Output

Ordering Information(1)

8. Scrolling through the datasheet, we can find the remaining relevant information. For example, under the table of ‘Electrical Characteristics (LM7810)’, we see relevant information about **load regulation, line regulation,** and **ripple rejection**.

Electrical Characteristics (LM7810)

Refer to the test circuit, -40°C < T_J < 125°C, I_O = 500 mA, V_I = 16 V, C_I = 0.33 µF, C_O = 0.1 µF, unless otherwise specified.

Symbol	Parameter	Conditions		Min.	Typ.	Max.	Unit
V_O	Output Voltage	T_J = +25°C		9.6	10.0	10.4	V
		I_O = 5 mA to 1 A, $P_O \leq$ 15 W, V_I = 12.5 V to 25 V		9.5	10.0	10.5	
Regline	Line Regulation[10]	T_J = +25°C	V_I = 12.5 V to 25 V		10	200	mV
			V_I = 13 V to 25 V		3	100	
Regload	Load Regulation[10]	T_J = +25°C	I_O = 5 mA to 1.5 A		12	200	mV
			I_O = 250 mA to 750 mA		4	400	
I_Q	Quiescent Current	T_J = +25°C			5.1	8.0	mA
ΔI_Q	Quiescent Current Change	I_O = 5 mA to 1 A				0.5	mA
		V_I = 12.5 V to 29 V				1.0	
$\Delta V_O/\Delta T$	Output Voltage Drift[11]	I_O = 5 mA			-1		mV/°C
V_N	Output Noise Voltage	f = 10 Hz to 100 kHz, T_A = +25°C			58		µV
RR	Ripple Rejection[11]	f = 120 Hz, V_I = 13 V to 23 V		56	71		dB
V_{DROP}	Dropout Voltage	I_O = 1 A, T_J = +25°C			2		V
R_O	Output Resistance[11]	f = 1 kHz			17		mΩ
I_{SC}	Short-Circuit Current	V_I = 35 V, T_J = +25°C			250		mA
I_{PK}	Peak Current[11]	T_J = +25°C			2.2		A

Notes:

10. Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.
11. These parameters, although guaranteed, are not 100% tested in production.

Notice that we have a ripple rejection of at least $56\ dB$ (varies per part, is $71\ dB$ on average). We also have load and line regulation figures, given in mV. Normalizing these by $V_{OUT} \cong 10\ V$ would give us load and line regulation in the worst case ('Max.' column) of a few percent – these are clearly good regulators. Lastly, we can also see under the table 'Absolute Maximum Ratings' some important information to **check later**:

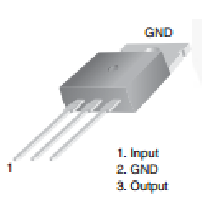
Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only. Values are at T_A = 25°C unless otherwise noted.

Symbol	Parameter		Value	Unit
V_I	Input Voltage	V_O = 5 V to 18 V	35	V
		V_O = 24 V	40	
$R_{\theta JC}$	Thermal Resistance, Junction-Case (TO-220)		5	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-Air (TO-220)		65	°C/W
T_{OPR}	Operating Temperature Range	LM78xx	-40 to +125	°C
		LM78xxA	0 to +125	
T_{STG}	Storage Temperature Range		- 65 to +150	°C

Notice that for our version ($V_O = 10\ V$, first line), the Input Voltage must not exceed $35\ V$. Thus, our actual range of V_{IN} if we use this part is $V_{IN} \sim 12V\ to\ 35V$. We will need to check later (after selecting the transformer and rectifier) to ensure V_{IN} does not exceed this limit. Otherwise, this seems to be a suitable regulator. If we select it, we should also look at the recommended application diagram:

Typical Applications (Continued)



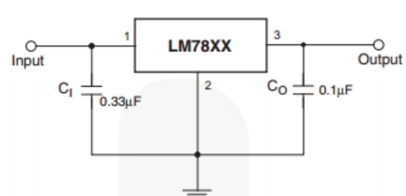


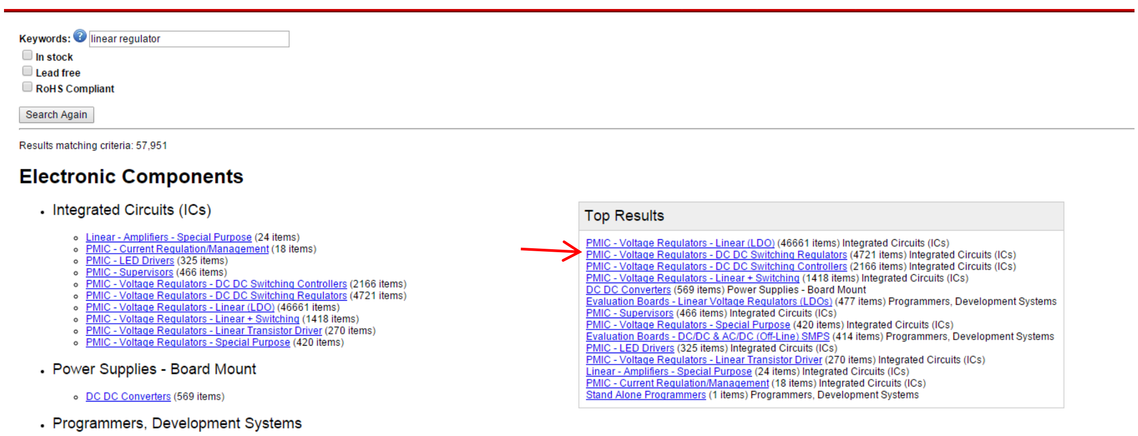
Figure 9. Fixed-Output Regulator

Notice that to actually use the part, we need two additional components – two capacitors. Since they are small in value, they will not add significant cost – as predicted, the linear regulator is cheap and simple to use. Our selection is complete, aside from checking the maximum ratings at the very end.

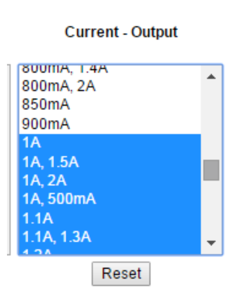
Switching Regulator Selection Process

If we desired, we could also consider a switching regulator as an option. This would be best for a design targeting high efficiency as a secondary parameter, since for this example there are no other compelling reasons (high power output, difficult V_{IN} range) to select one. We expect it to be more expensive and require more extra parts.

1. As before, go to a manufacturer website. For a category, this time you should search for a 'switching regulator'. Note that switching **controllers** are a sub-component of a switching regulator; think of them as a 'build-your-own' option – we will skip them here.



2. As before, you can use the minimum V_{IN}, the I_{LOAD}, and the desired V_{OUT} to narrow down the selection. You may notice that **fixed** output types are less common; this makes selection more difficult. There is a similar problem for V_{IN} ranges. In general, it is simplest to select the range of I_{LOAD} first, and then to sort by secondary characteristics (cost, etc.). Selecting all types with $I_{LOAD} \geq 1\ A$ and sorting by price gives the following:



Compare Parts		Image	Digi-Key Part Number	Manufacturer Part Number	Manufacturer	Description	Quantity Available	Unit Price CAD	Minimum Quantity	Packaging	Series	Type	Output Type	Number of Outputs	Voltage - Output	Voltage - Input	Frequency - Switching	Current - Output	Synchronous Rectifier	Operating Temperature	Mounting Type	Package / Case	Supplier Device Package
			AZ34063UMTR-G1DICT-ND	AZ34063UMTR-G1	Diodes Incorporated	IC REG BUCK BOOST INV 1.5A 8SOIC	3,157 - Immediate	0.19822 @ qty 10,000	1	Cut Tape (CT) Alternate Packaging	-	Step-Down (Buck), Step-Up (Boost), Inverting	Adjustable	1	1.25 V ~ 36 V	3 V ~ 36 V	Up to 180kHz	1.5A	No	-40°C ~ 85°C	Surface Mount	8-SOIC (0.154", 3.90mm Width)	8-SOIC
			AZ34063UMTR-G1DIDKR-ND	AZ34063UMTR-G1	Diodes Incorporated	IC REG BUCK BOOST INV 1.5A 8SOIC	3,157 - Immediate	Digi-Reel®	1	Digi-Reel® Alternate Packaging	-	Step-Down (Buck), Step-Up (Boost), Inverting	Adjustable	1	1.25 V ~ 36 V	3 V ~ 36 V	Up to 180kHz	1.5A	No	-40°C ~ 85°C	Surface Mount	8-SOIC (0.154", 3.90mm Width)	8-SOIC
			PAM2312AABADJDICT-ND	PAM2312AABADJ	Diodes Incorporated	IC REG BUCK SYNC ADJ 1A SOT25	2,462 - Immediate	0.21274 @ qty 10,000	1	Cut Tape (CT) Alternate Packaging	-	Step-Down (Buck)	Adjustable	1	0.6 V ~ 5.5 V	2.5 V ~ 5.5 V	1.5MHz	1A	Yes	-40°C ~ 85°C	Surface Mount	SOT-23-5 Thin, TSOT-23-5	TSOT-2
			PAM2312AABADJDIDKR-ND	PAM2312AABADJ	Diodes Incorporated	IC REG BUCK SYNC ADJ 1A SOT25	2,462 - Immediate	Digi-Reel®	1	Digi-Reel® Alternate Packaging	-	Step-Down (Buck)	Adjustable	1	0.6 V ~ 5.5 V	2.5 V ~ 5.5 V	1.5MHz	1A	Yes	-40°C ~ 85°C	Surface Mount	SOT-23-5 Thin, TSOT-23-5	TSOT-2
			AP3418KTR-G1DITR-ND	AP3418KTR-G1	Diodes Incorporated	IC REG BUCK SYNC ADJ 1.5A SOT25	3,000 - Immediate 33,000 - Factory Stock	0.21578 @ qty 12,000	3,000	Tape & Reel (TR) Alternate Packaging	-	Step-Down (Buck)	Adjustable	1	0.6 V ~ 5.5 V	2.5 V ~ 5.5 V	1.4MHz	1.5A	Yes	-40°C ~ 85°C	Surface Mount	SC-74A, SOT-753	SOT-23-
			AP3417CDNTR-G1DITR-ND	AP3417CDNTR-G1	Diodes Incorporated	IC REG BUCK ADJ 1A 6DFN	3,000 - Immediate 1,368,000 - Factory Stock	0.21578 @ qty 12,000	3,000	Tape & Reel (TR) Alternate Packaging	-	Step-Down (Buck)	Adjustable	1	0.6 V ~ 4.95 V	2.5 V ~ 5.5 V	1.5MHz	1A	Yes	-40°C ~ 85°C	Surface Mount	6-WDFN Exposed Pad	6-DFN (2
			497-7852-2-ND	MC34063ECD-TR	STMicroelectronics	IC REG BUCK BOOST INV ADJ 8SOIC	27,500 - Immediate	0.22559 @ qty 10,000	2,500	Tape & Reel (TR) Alternate Packaging	-	Step-Down (Buck), Step-Up (Boost), Inverting	Adjustable	1	1.25 V ~ 38 V	3 V ~ 40 V	100kHz	1.5A	No	0°C ~ 70°C	Surface Mount	8-SOIC (0.154", 3.90mm Width)	8-SO
			497-7851-2-ND	MC34063EBD-TR	STMicroelectronics	IC REG BUCK BOOST INV ADJ 8SOIC	2,500 - Immediate 20,000 - Factory Stock	0.24520 @ qty 10,000	2,500	Tape & Reel (TR) Alternate Packaging	-	Step-Down (Buck), Step-Up (Boost), Inverting	Adjustable	1	1.25 V ~ 38 V	3 V ~ 40 V	100kHz	1.5A	No	-40°C ~ 125°C	Surface Mount	8-SOIC (0.154", 3.90mm Width)	8-SO
			497-7850-2-ND	MC34063ACD-TR	STMicroelectronics	IC REG BUCK BOOST INV ADJ 8SOIC	10,000 - Immediate	0.24913 @ qty 10,000	2,500	Tape & Reel (TR) Alternate Packaging	-	Step-Down (Buck), Step-Up (Boost), Inverting	Adjustable	1	1.25 V ~ 38 V	3 V ~ 40 V	100kHz	1.5A	No	0°C ~ 70°C	Surface Mount	8-SOIC (0.154", 3.90mm Width)	8-SO
			296-21745-2-ND	MC34063ADRJR	Texas Instruments	IC REG BUCK BOOST INV	1,000 - Immediate 10,000 - Factory	0.25569 @ qty 10,000	1,000	Tape & Reel (TR)	-	Step-Down (Buck), Step-Up	Adjustable	1	1.55 V ~ 40 V	3 V ~ 40 V	33kHz	1.5A	No	0°C ~ 70°C	Surface Mount	8-WDFN Exposed Pad	8-SON Exp Pad (4

Notice that these regulators are much more flexible. Although the ranges of V_{IN} and V_{OUT} are different, there are many types on this first page of results alone that could work. For instance, the very first result allows $V_{IN} \sim 1.25\ to\ 36V$, which works with our $V_{IN} \geq 12\ V$, and V_{OUT} adjustable from $3 \sim 36V$, which is good for $V_{OUT} = 10\ V$. It also provides a safety factor for $I_{LOAD} = 1.5A$.

3. Selecting the datasheet for this part, we check the remaining parameters and circuit needed:

Data Sheet

1.5A STEP-DOWN/STEP-UP/INVERTING DC-DC CONVERTER AZ34063U

General Description

The AZ34063U is a monolithic switching regulator control circuit which contains the primary functions required for DC-DC converters. This device consists of internal temperature compensated reference, voltage comparator, controlled duty cycle oscillator with active current limit circuit, driver and high current output switch.

The AZ34063U is specifically designed as a general DC-DC converter to be used in Step-Down, Step-Up and Voltage-Inverting applications with a minimum number of external components.

The AZ34063U is available in 2 packages: SOIC-8 and DIP-8.

Features

- Operation from 3.0V to 36V Input
- Low Standby Current
- Current Limiting
- Output Switch Current to 1.5A
- Output Voltage Adjustable
- Operation Frequency up to 180kHz
- Precision 2% Reference

Applications

- Battery Chargers
- ADSL Modems
- Hubs
- Negative Voltage Power Supplies

We already know the maximum V_{IN} from earlier. Searching the specifications for load and line regulation, as well as ripple rejection, we do not find anything. The reason is that for switching regulators, these figures **depend on the external parts connected to the regulator**, and thus must be measured using a prototype. Looking through the typical applications, we find one that could be adapted to suit our needs:

1.5A STEP-DOWN/STEP-UP/INVERTING DC-DC CONVERTER **AZ34063U**

Typical Applications (Continued)

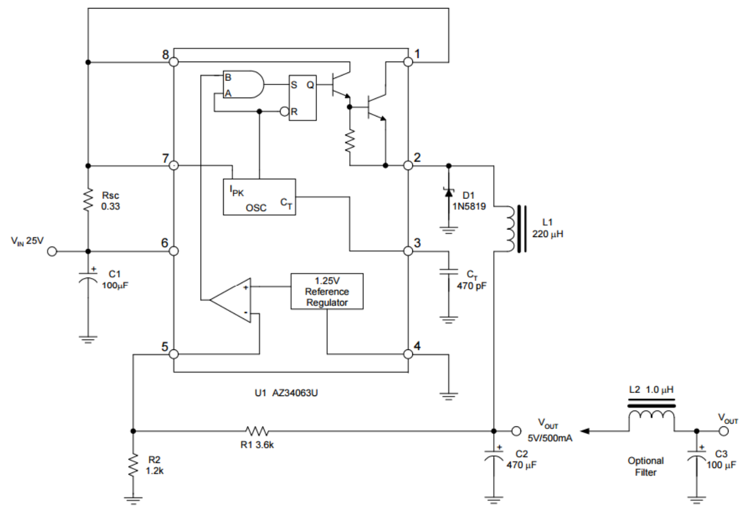


Figure 15. Step-Down converter (Note 6)

Note 6: This is a typical step-down converter configuration. The working process in the steady state is similar to step-up converter, $V_{PIN5}=V_{OUT}*R2/(R1+R2)=1.25$ (V), the output voltage can be decided by $V_{OUT}=1.25*(R1+R2)/R2$ (V).

Although the output voltage is wrong, we need to read more into the datasheets for these regulator types. Notice the note on the bottom: the output voltage is set by selecting R_1 and R_2 in the circuit above; it could easily be changed to output $10V$. And, since this is a **step-down** circuit (same note), it should work in our case where $V_{IN} > V_{OUT}$ always. Thus, we can use this regulator, but we will not know more details until a prototype is built. Some datasheets **may** provide these numbers for common applications, but it is not guaranteed.

Finally, notice that what we said about this regulator type earlier holds true. There are **many** more parts needed than the earlier example, including a large capacitor ($470\mu F$), a diode, and at least one inductor. This will add to cost and complexity. Given the low total power output, this circuit will **also** be physically bigger – the size benefit of a switching regulator is only realized at high power. One definite benefit to note is the efficiency, though; the above circuit could easily be 80-90% efficient, which the linear regulator cannot match. For example, if $V_{IN} = 20\ V$, the linear regulator from before will be about 50% efficiency, while the switching regulator could still be 80-90%. The efficiency numbers will be closer for lower V_{IN}, but generally better for the switching type at all levels.

For the design assignment, you **do not** need to go further into the design than selecting one of the typical applications. So, using the above circuit **directly** would be acceptable, even if you do not change R_1, R_2, etc. When in doubt, please ask the instructor or TAs for help, especially if you choose to use this type of regulator.